Stoller
Grand Junction Office established 1959

699-S6-E4L (C4073)
Log Data Report

Borehole Information:

Borehole: 699-S6-E4L (C4073)			**Site:** 618-10 Burial Ground		
Coordinates (WA State Plane)		**GWL (ft)[1]:** 64.2		**GWL Date:** 2/20/2003	
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A[3]	N/A	2/20/2003	N/A	87.5	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	2.6	8 3/4	7 3/4	1/2	+2.6	89.0
The geologist was the source for the casing information and all depths.						

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe. This borehole is located approximately 30 ft southeast of the 618-10 Burial Ground.

Logging Equipment Information:

Logging System:	Gamma 3E (RLS-1)		**Type:** 70% HPGe
Calibration Date:	10/02	**Calibration Reference:**	GJO-2002-386-TAR
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 3F (RLS-1)		**Type:** Moisture (H380932510)
Calibration Date:	02/03	**Calibration Reference:**	GJO-2003-417-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2/Repeat	3	4	5
Date	2/20/03	2/20/03			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	75.0			
Finish Depth (ft)	85.0	85.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	n/a[4]	n/a			
Pre-Verification	CE101CAB	CE101CAB			
Start File	CE111000	CE111086			

Log Run	1	2/Repeat	3	4	5
Finish File	CE111085	CE111096			
Post-Verification	CE111CAA	CE111CAA			
Depth Return Error (in.)	0	0			
Comments	None	None			

Neutron-Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2/Repeat	3	4
Date	2/21/03	2/21/03		
Logging Engineer	Pearson	Pearson		
Start Depth (ft)	0.0	57.0		
Finish Depth (ft)	64.0	63.0		
Count Time (sec)	n/a	n/a		
Live/Real	n/a	n/a		
Shield (Y/N)	N	N		
MSA Interval (ft)	0.25	0.25		
ft/min	0.9	0.9		
Pre-Verification	CF022CAB	CF022CAB		
Start File	CF022000	CF02257		
Finish File	CF022256	CF022280		
Post-Verification	CF022CAA	CF022CAA		
Depth Return Error (in.)	n/a	1 low		
Comments	None	None		

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed with a centralizer installed on the sonde. Data were collected using Gamma 3E, HO 68B-4330. Pre- and post-survey verification measurements for the RLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 118. Fine-gain adjustments were not needed to maintain the 1460-keV (^{40}K) photopeak at a pre-described channel.

Analysis Notes:

Analyst:	Sobczyk	Date:	2/26/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The verification spectra were all within the control limits. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for the day were stable and between 1 and 3 percent of one another.

NMLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits established on 12/05/2002. The verification spectra were all within the control limits.

SGLS log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G3Eoct02.xls), using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. Data were analyzed using a uniform casing correction based on a casing thickness of 0.5 in. to a depth of 85 ft. This casing thickness was measured at the wellhead. A water correction was applied to the data below 64.2 ft.

For the 70% HPGe detector, dead time at background count rates varies from 2 to 6 percent, averaging about 4 percent. Dead time corrections are required when dead time exceeds 18 percent. As the dead time did not exceed 18 percent, a dead time correction was not needed or applied.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Zero reference was the ground surface. Data were analyzed using a uniform casing correction based on a casing thickness of 0.28 in. to a depth of 64 ft. Calibration data are based on 8-in. casing with a thickness of 0.32 in. This casing thickness is thinner than the 0.5-in.-thick drill pipe that was present during logging. A constant was applied to the data to compensate for the to 0.5-in. steel casing to estimate the actual volume fraction of water present at the time of logging.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, gross gamma and volume fraction of water, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

At the bottom of the borehole, the KUT concentrations appear abnormally high. The apparent concentrations are elevated because the sonde is near the open end of the drill pipe, and the casing correction is overcompensating for the shielding effect of the drill pipe. Thus, the KUT concentrations were plotted at the usual scales, and the KUT concentrations were allowed to go off-scale at the bottom of the borehole.

Results and Interpretations:

Man-made radionuclides were not detected in this borehole. ^{137}Cs was indicated at 81 ft during the repeat survey. After examination of the spectrum at this depth, it was determined that there is no evidence of a photopeak at 662 keV. This reported peak is probably the result of statistical fluctuation.

The plots of the repeat logs demonstrate reasonable repeatability of the RLS data for the natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV. The ^{238}U concentrations based on the 1764-keV photopeak do not repeat at 78 and 82 ft.

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[1] GWL – groundwater depth
[2] TOC – top of casing
[3] N/A – not available
[4] n/a – not applicable

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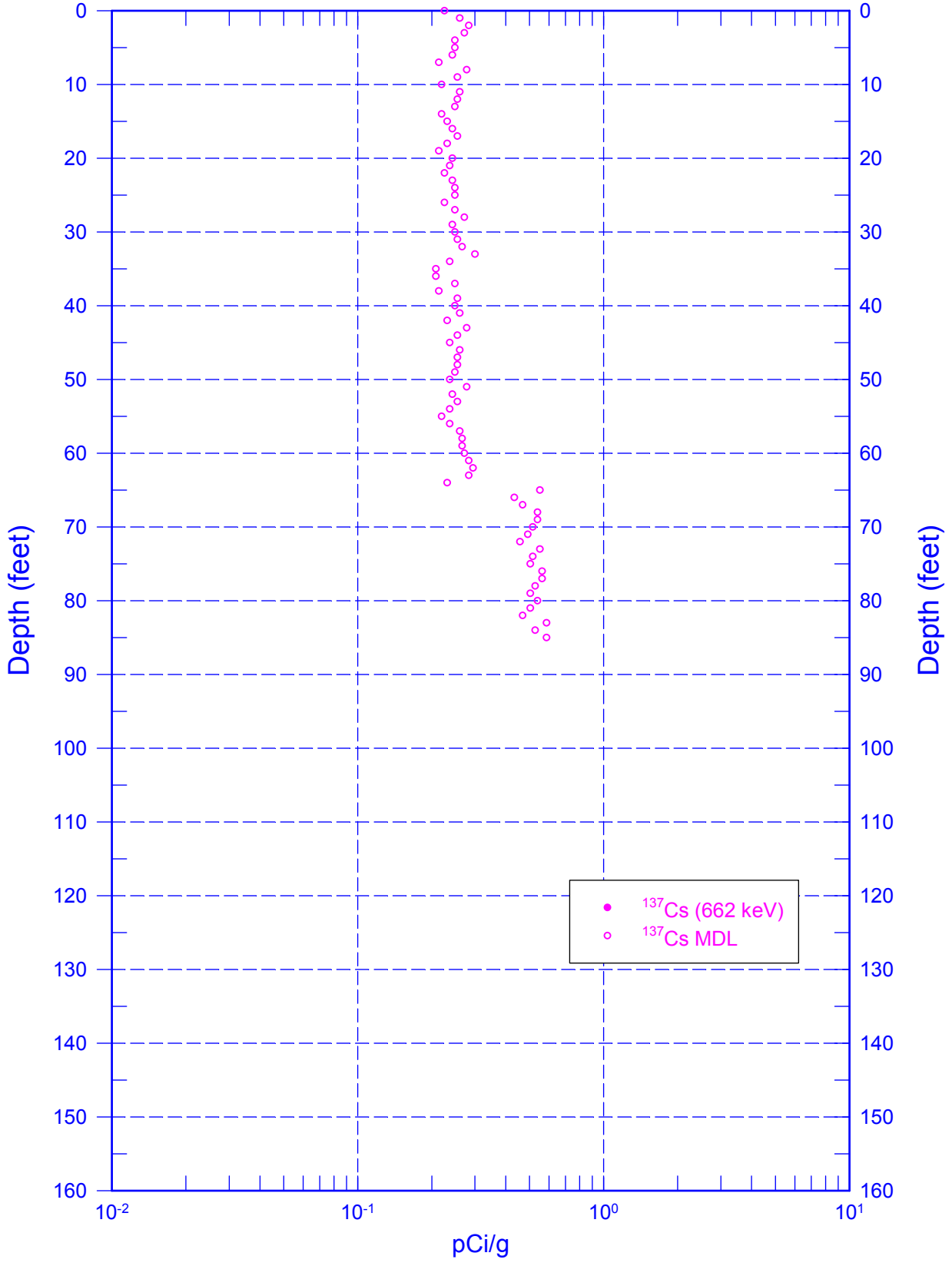
Man-Made Radionuclides



Zero Reference = Ground Surface

Date of Logging Run
2/20/2003

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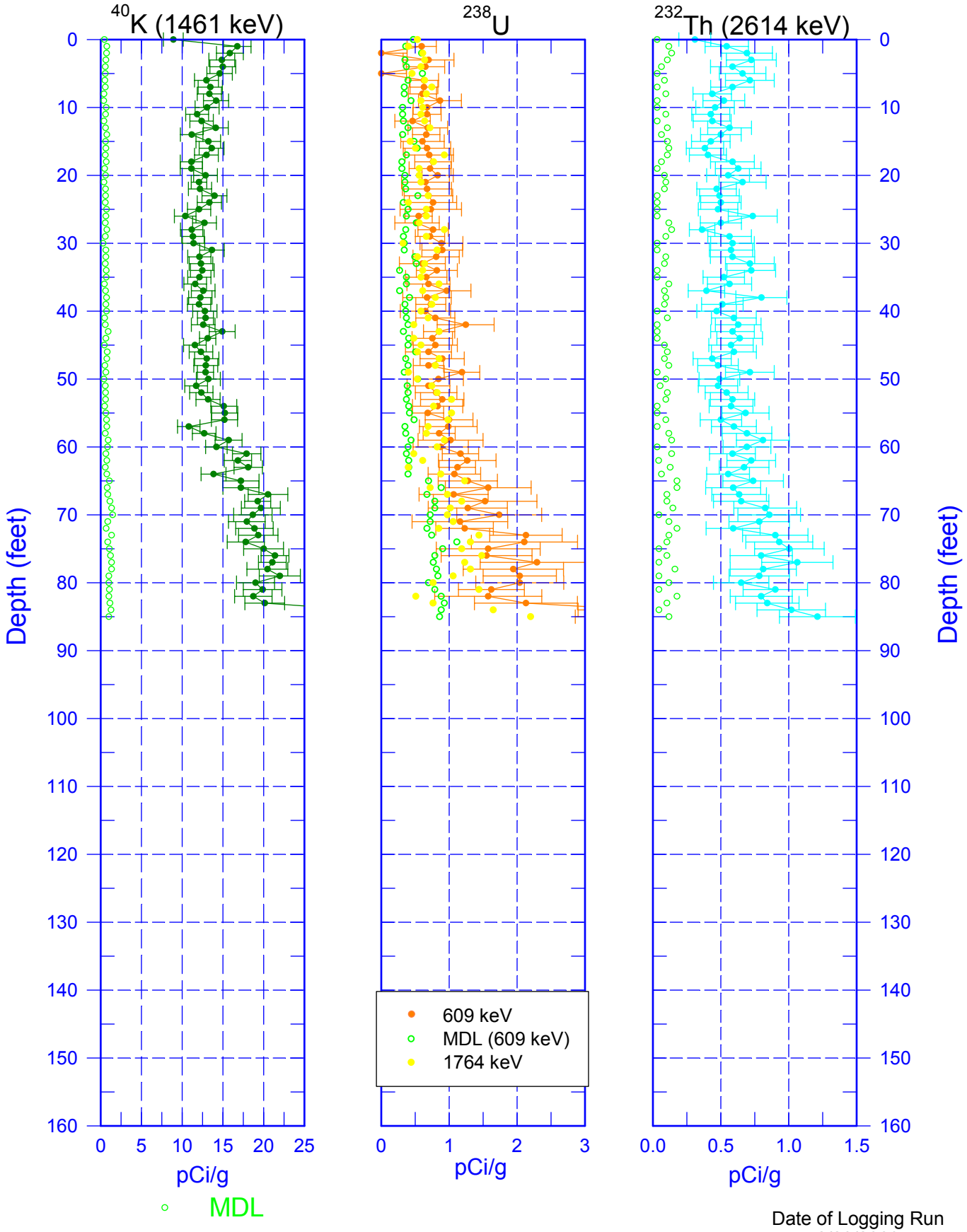
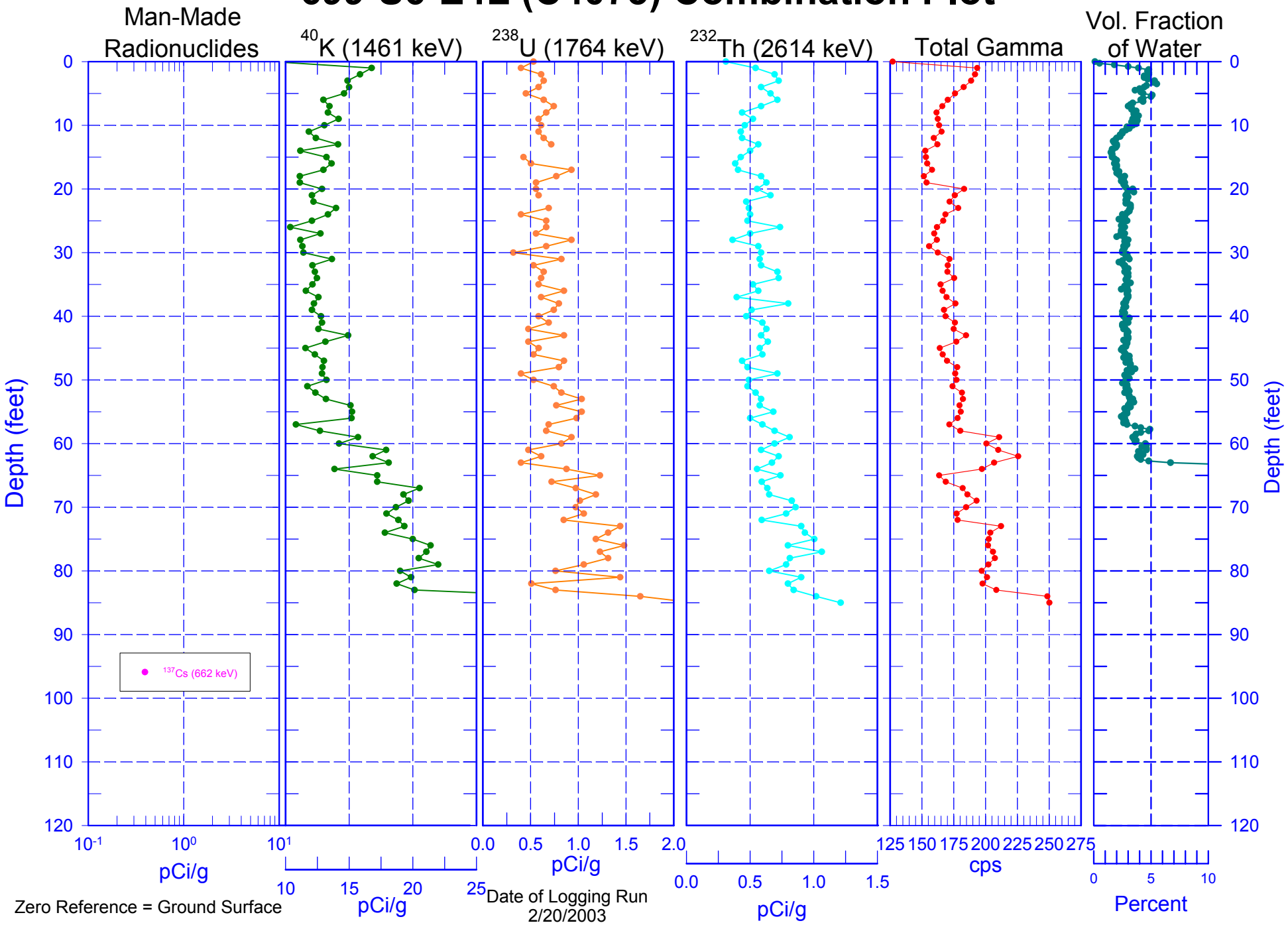
Natural Gamma Logs



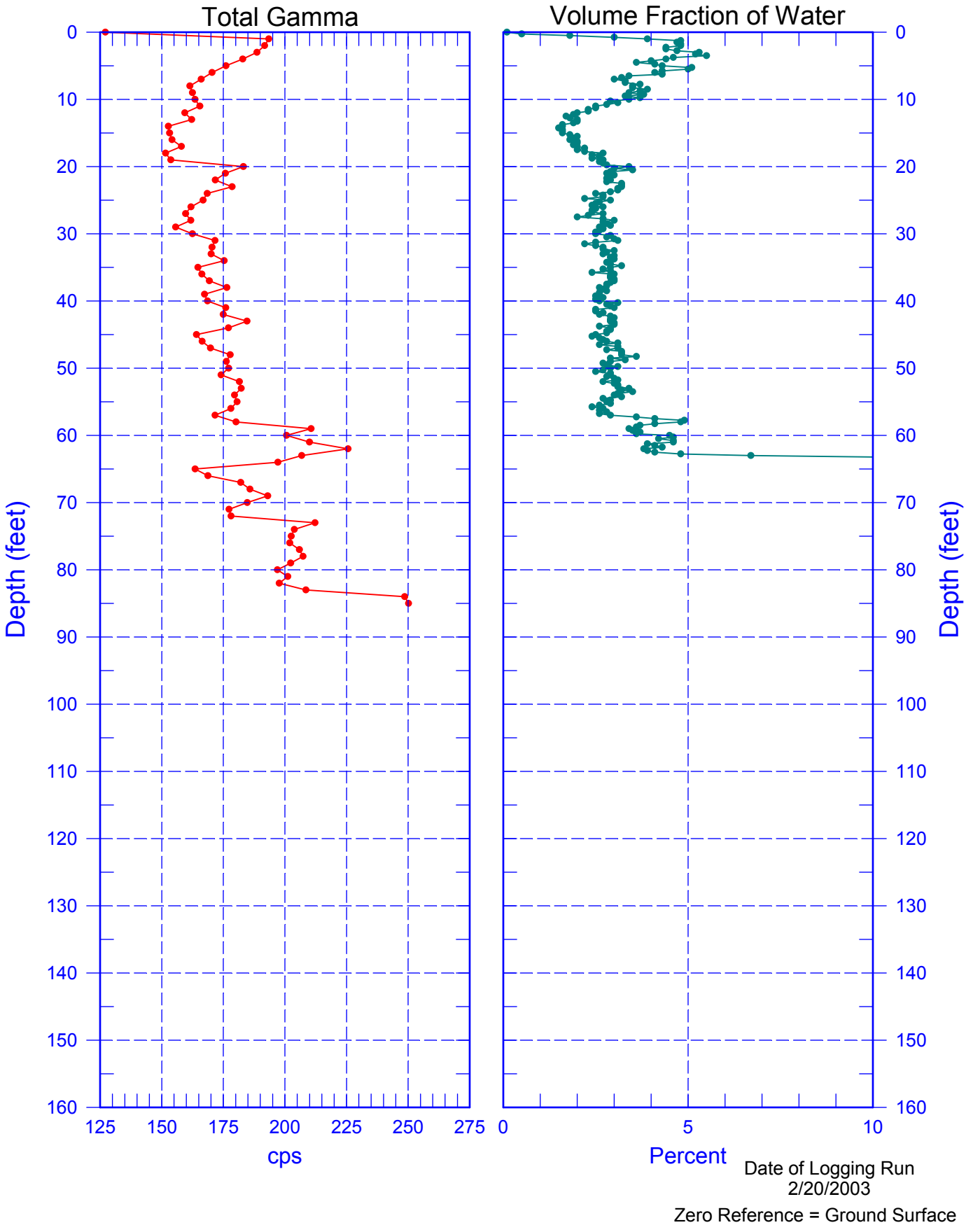
Zero Reference = Ground Surface

Date of Logging Run
2/20/2003

699-S6-E4L (C4073) Combination Plot



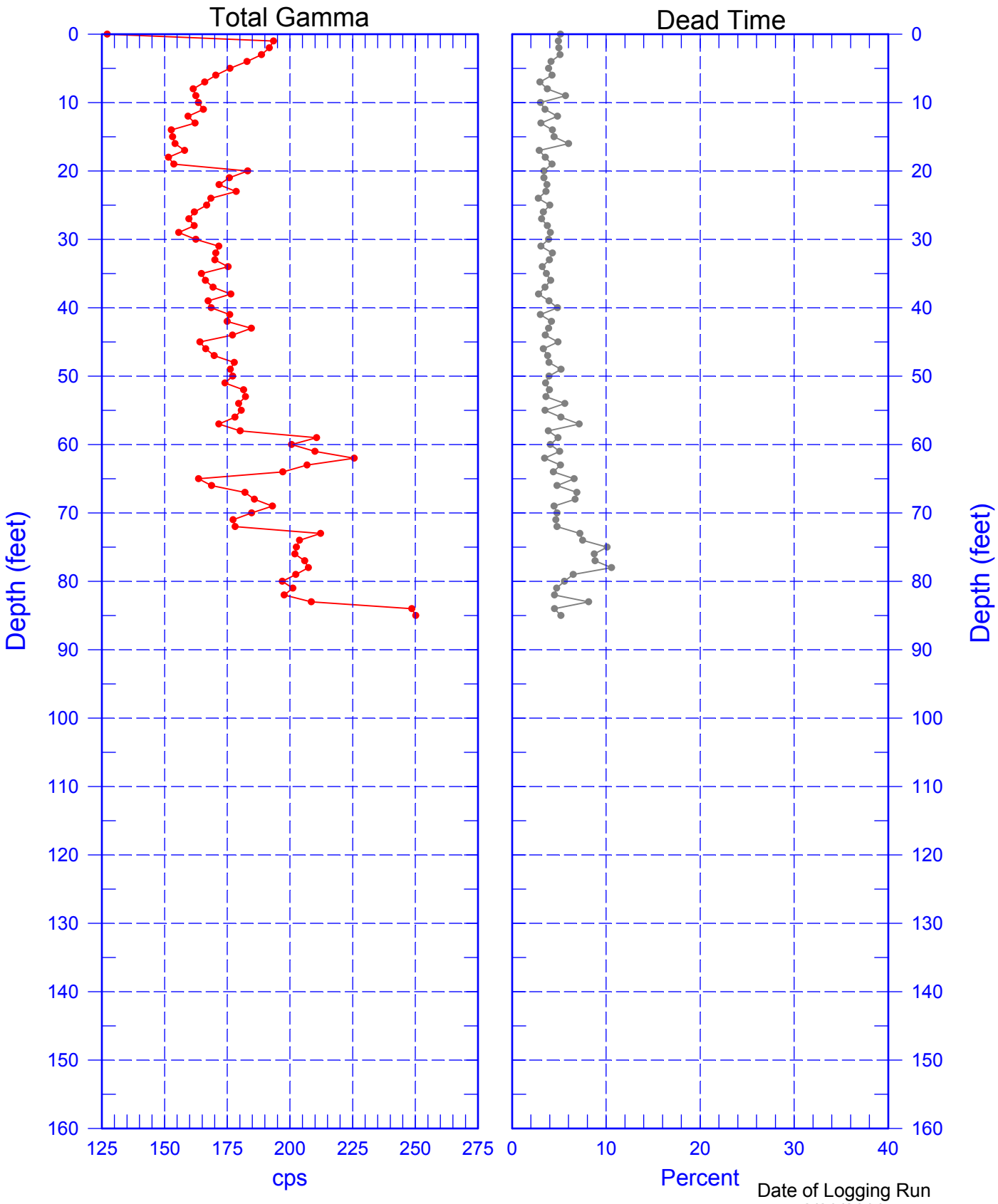
699-S6-E4L (C4073)
Total Gamma & Neutron



Date of Logging Run
2/20/2003

Zero Reference = Ground Surface

699-S6-E4L (C4073)
Total Gamma & Dead Time



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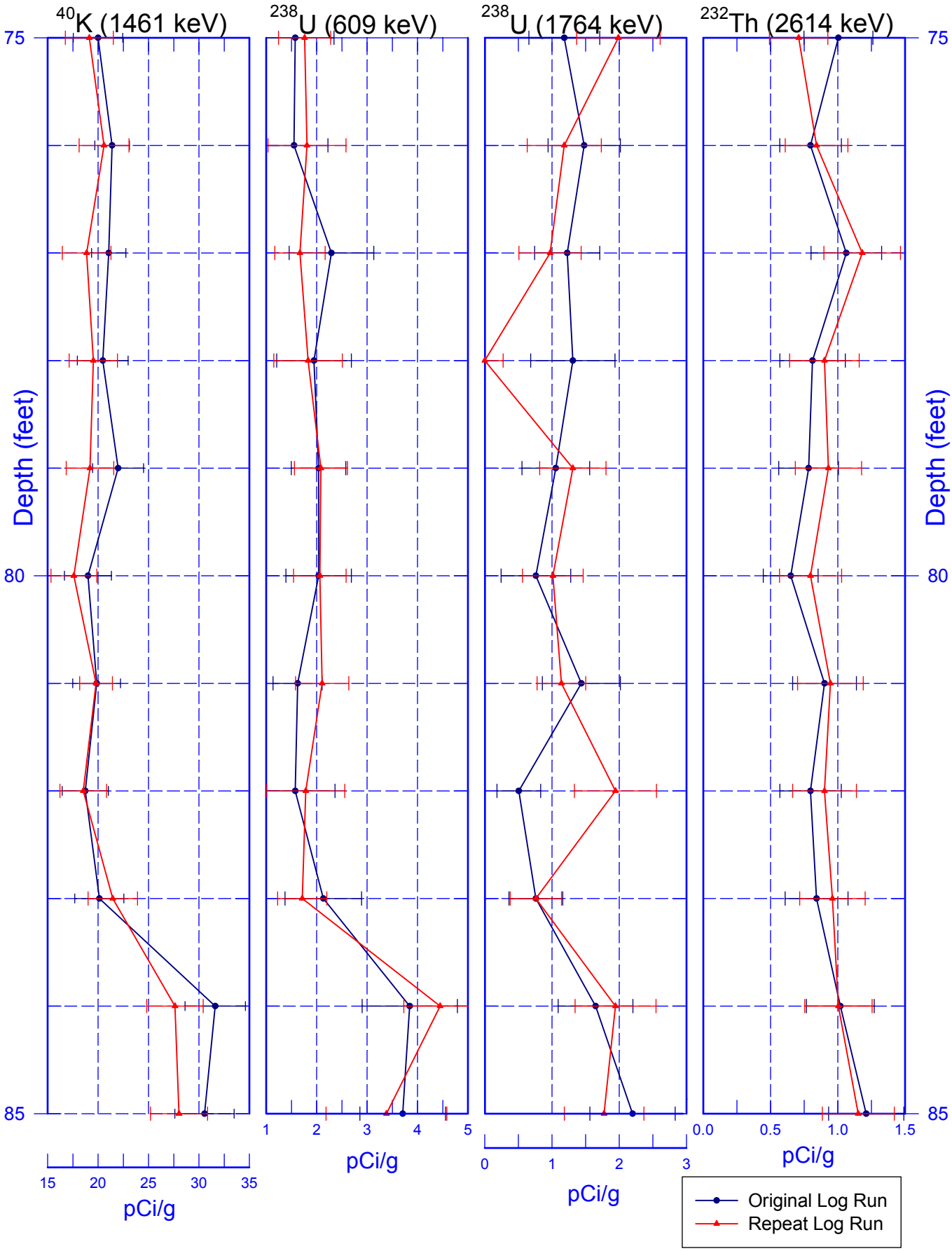
Rerun of Natural Gamma Logs (75.0 to 85.0 ft)



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Volume Fraction of Water Rerun